

CLAIMS

1. A test method, comprising:
 - squeezing a thermal interface material (TIM)
 - 5 sample at a plurality of different pressures at different times;
 - flowing heat through said TIM sample to create a thermal gradient between a heat source and a cold sink at each of said plurality of different pressures;
 - 10 measuring temperatures at a plurality of points along said thermal gradient at respective ones of said plurality of different pressures; and
 - characterizing the thermal material properties of said TIM sample from calculations based on data obtained in
 - 15 the step of measuring.
2. The method of Claim 1, further comprising:
 - maintaining a constant pressure at each of said plurality of different pressures in spite of any thermal
 - 20 expansions of said TIM sample during a test.
3. The method of Claim 1, further comprising:
 - delaying the step of characterizing until temperature measurements in the step of measuring have
 - 25 reached a steady-state.
4. The method of Claim 1, further comprising:
 - delaying the step of characterizing until temperature measurements in the step of measuring should
 - 30 have reached a steady-state according to a previous trial run of said TIM sample.
5. The method of Claim 1, further comprising:
 - first making a trial run of said TIM sample to
 - 35 determine a particular set of pressures to use in the step of squeezing.

6. The method of Claim 4, further comprising:
first making a trial run of said TIM sample to
determine a time delay needed for steady-state thermal
5 conditions.

7. The method of Claim 1, further comprising:
first making a trial run of said TIM sample to
determine heating and cooling requirements needed to
10 establish said thermal gradient.

8. The method of Claim 1, further comprising:
computing a thermal resistance curve across
intervening hot and cold blocks along said thermal gradient
15 to extrapolate interface temperatures on opposite sides of
said TIM sample; and
using such interface temperatures in a calculation
of the thermal resistance of said TIM sample at each of said
plurality of different pressures.

20

9. The method of Claim 8, further comprising:
determining a relationship between temperature and
distance along each of the hot and cold blocks at steady-
state with simple linear regression.

25

10. A materials testing system, comprising:
a fixture for placing a thermal interface material
(TIM) between a hot and a cold copper block;
a press for squeezing the TIM between the hot and
30 cold copper blocks at a plurality of pressures and for a
plurality of durations according to a test profile;
a heater and cooler connected to the hot and cold
copper blocks for creating a thermal gradient across the
TIM;
35 a compensating controller adjusting the pressure
applied to the TIM to be constant even though said TIM

sample expands and contracts with changes in its temperature;

5 a set of sensors for collecting temperature information from the hot and cold copper blocks during the steps of squeezing and creating; and

a computer for building a thermal-resistance-curve model of said TIM sample from data obtained in the step of collecting temperature information.

10 11. The system of Claim 10, further comprising:
a gauge for measuring the thickness of said TIM sample at room temperature and at a test temperature.

15 12. The system of Claim 10, further comprising:
a computer for calculating a net heat passing through said TIM sample to account for heat losses to the environment, and providing for a more accurate thermal resistance value to be estimated.

20 13. The system of Claim 10, further comprising:
a plurality of thermocouples strategically disposed in the hot and cold blocks;
a computer for calculating a least-squares fit, with R^2 better than 0.99, that means better than 99% of the
25 variability in temperature is related to the differences in distance.

14. The system of Claim 10, further comprising:
a plurality of thermocouples strategically located
30 and connected to provide data for a least-squares-fit for reducing a dependency on individual thermocouple accuracy.

15. A materials testing method, comprising:
placing a thermal interface material (TIM) in a
35 fixture between a hot and a cold copper block with parallel opposing faces;

squeezing said TIM sample between said opposing faces at a plurality of pressures and for a plurality of durations according to a test profile;

5 creating a thermal gradient across the TIM with a heater and cooler connected to the hot and cold copper blocks;

 adjusting the pressure applied to the TIM to be constant even though said TIM sample expands and contracts with changes in its temperature;

10 collecting temperature information from the hot and cold copper blocks during the steps of squeezing and creating; and

 building a thermal-resistance-curve model of said TIM sample from data obtained in the step of collecting
15 temperature information.

16. The method of claim 15, further comprising:

 automatically positioning said parallel opposing faces to maintain parallelism between two contact surfaces
20 so such precision is not operator dependent.

17. The method of claim 15, further comprising:

 using no operator involvement in test fixture assembling and offline measurements.
25

18. The method of claim 15, further comprising:

 applying pressure between said parallel opposing faces in the range of a few pounds to in excess of 400 pounds.
30

19. The method of claim 15, further comprising:

 using cyclic tests for special evaluation without returning to a starting point.

35 20. The method of claim 15, further comprising:

non-uniformly heating said TIM sample with a
secondary heating block.

21. The method of claim 15, further comprising:
5 heating TIM samples from both sides during a pre-
conditioning phase to minimize wait time.

22. The method of claim 15, further comprising:
measuring TIM sample load and deflection
10 simultaneously.

23. The method of claim 15, further comprising:
correlating TIM sample load and deflection.